

## Assembly Instructions MP-C Serial, Control Interface

### Introduction

The MP-C Control Interface is a 5 1/4" x 3 1/2" double sided, plated thru hole board which is meant to interface a serial terminal to the Computer System for both system control and when selected, user program input/output. It may be jumper configured to operate serially at either 110 baud (10 characters/second) or 300 baud (30 characters/second) with an upper case ASCII terminal RS-232C or 20 Ma TTY compatible. Baudot coded TTY's are not compatible with this interface, they must be ASCII coded. Our CT-1024 terminal system kit, however, is compatible. All terminal input/output data is made thru a ten pin connector installed along the top edge of the board. Power for the board is supplied by a +5V voltage regulator and has a current consumption of approximately 0.2A.

When the SWTPC 6800 Computer System is being assembled, work on only one board at a time. Each of the system's boards and their associated parts must not be intermixed to avoid confusion during assembly. The MOS integrated circuits supplied with this kit are susceptible to static electricity damage and for this reason have been packed with their leads impressed onto a special conductive foam or possibly wrapped in a conductive foil. In either case, do not remove the protective material until specifically told to do so later in the instructions.

### PC Board Assembly

NOTE: Since all of the holes on the PC board have been plated thru, it is only necessary to solder the components from the bottom side of the board. The plating provides the electrical connection from the "BOTTOM" to ~~the~~ "TOP" foil of each hole. Unless otherwise noted it is important that none ~~of~~ the connections be soldered until all of the components of each group have been installed on the board. This makes it much easier to interchange components if a mistake is made during assembly. Be sure to use a low wattage iron (not a gun) with a small tip. Do not use acid core solder or any type of paste flux. We will not guarantee or repair any kit on which either product has been used. Use only the solder supplied with the kit or a 60/40 alloy resin core equivalent. Remember all of the connections are soldered on the bottom side of the board only. The plated-thru holes provide the electrical connection to the top foil.

- (✓) Before installing any parts on the circuit board, check both sides of the board over carefully for incomplete etching and foil "bridges" or "breaks". It is unlikely that you will find any but should there be on especially on the "TOP" side of the board it will be very hard to locate and correct after all of the components have been installed on the board.
- (✓) Attach all of the resistors to the board. As with all other components unless noted, use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. Solder.



- (✓) Install all of the capacitors on the board. Solder.
- (✓) Install the transistors and diodes on the board. The diodes must be turned so the banded end corresponds with that shown on the component layout drawing, and the transistors must be turned to match the outlines on the component layout drawing as well. Sandwich the nylon spacer between the body of transistor Q2 and the circuit board. Solder.
- ( ) Starting from one end of the circuit board install each of the three, 10 pin Molex female edge connectors along the lower edge of the board. These connectors must be inserted from the "TOP" side of the board and must be pressed down firmly against the board. Make sure the body of the connector seats firmly against the circuit board and that each pin extends completely into the holes on the circuit board. Not being careful here will cause the board to either wobble and/or be crooked when plugged onto the mother board. It is suggested that you solder only the two end pins of each of the three connectors until all have been installed at which time if everything looks straight and rigid you should solder the as yet unsoldered pins.
- (✓) Following the procedure outlined above, attach the remaining 10 pin Molex female edge connector along the upper edge of the board.
- (✓) Insert the small nylon indexing plugs into both the upper and lower edge connector pins indicated by the small triangular arrow on the "BOTTOM" side of the circuit board. This prevents the board and I/O connector from being accidentally plugged on incorrectly.
- (✓) Install integrated circuits IC5 thru IC9. As each one is installed make sure it is down firmly against the board and solder only two of the leads to hold the pack in place while the other IC's are being inserted. Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The semicircle notch, dot or bar on the end of the package is used for orientation purposes and must match with the outlines shown on the component layout drawing for each of the IC's. After inserting all of the integrated circuits go back and solder each of the as yet unsoldered pins.
- (✓) Install integrated circuit IC2 on the circuit board. This component must be oriented so its metal face is facing the circuit board as is secured to the circuit board with a #4 -40 x 1/4" screw, lockwasher and nut. A heatsink is not used. The three leads of the integrated circuit must be bent down into each of their respective holes. Solder.

NOTE: MOS integrated circuits are susceptible to damage by static electricity. Although some degree of protection is provided internally within the integrated circuits, their cost demands the utmost in care. Before opening and/or installing any MOS integrated circuits you should ground your body and all metallic tools coming into contact with the leads, thru a 1 M ohm 1/4 watt resistor (supplied with the kit). The ground must be an "earth" ground such as a water pipe, and not the circuit board ground. As for the connection to your body, attach a clip lead to your watch or metal ID bracelet. Make absolutely sure you have the 1 Meg ohm resistor connected between you and the "earth" ground, otherwise you will be creating a dangerous shock hazard. Avoid touching the leads of the integrated circuits any more than necessary when



installing them, even if you are grounded. On those MOS IC's being soldered in place, the tip of the soldering iron should be grounded as well (separately from your body ground) either with or without a 1 Meg ohm resistor. Most soldering irons having a three prong line cord plug already have a grounded tip. Static electricity should be an important consideration in cold, dry environments. It is less of a problem when it is warm and humid.

- (✓) Install MOS integrated circuits IC1, IC3 and IC4 following the precautions given in the preceding section. As each is installed, make sure it is down firmly against the board before soldering all of its leads. Be very careful to install each in it's correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The "dot" or "notch" on the end of the package is used for orientation purposes and must match with that shown on the component layout drawing for each of the IC's.
- ( ) The board should now be jumper programmed for either 110 baud (10 characters per second) or 300 baud (30 characters per second) operation. It is desirable to program the board for 300 baud operation if possible (RS-232 only). For 110 baud operation jumper point "C" on the board to the "110" point just to the left of point "C". Also jumper point "D" on the board to the "110" point just to the left of point "D". For 300 baud operation jumper point "C" on the board to the "300" point just to the left of point "C". Also jumper point "D" on the board to the "300" point just to the left of point "D". Make these connections using two 1" pieces of light gauge insulated wire and attach them so they may easily be removed should you wish to reconfigure the board at a later time. No connections should be made to the "A", "B", "NMI" and "IRQ" points.
- (✓) Working from the "TOP" side of the circuit board, fill in all of the feed-thru's with molten solder. The feed-thru's are those unused holes on the board whose internal plating connects the "TOP" and "BOTTOM" circuit connections. Filling these feed-thru's with molten solder guarantees the integrity of the connections and increases the current handling capability. Be sure not to fill in the holes marked "110", "300", "NMI", "A", "B" and "IRQ".
- ( ) Now that all of the components have been installed on the board, double check to make sure all have been installed correctly in their proper location.
- ( ) Check very carefully to make sure that all connections have been soldered. It is very easy to miss some connections when soldering which can really cause some hard to find problems later during checkout. Also look for solder "bridges" and "cold" solder joints which are another common problem.

Since the MP-C circuit board now contains MOS devices it is susceptible to damage from severe static electrical sources. One should avoid handling the board any more than necessary and when you must, avoid touching or allowing anything to come into contact with any of the conductors on the board.



## Input/Output (I/O) Connector Wiring

Actual I/O connections are made thru the 10 pin connector along the top edge of the board. The 10 pin male connector should be attached to the control terminal's cable as outlined in the instructions below and may be jumper configured for either RS-232 (TV typewriter format) or 20 Ma TTY (ASR-33 TTY format) operation. There are nine connection points on the I/O connector with the tenth used for indexing which prevents the male connector from being plugged on incorrectly. The function of each of the nine is abbreviated on the "BOTTOM" side of the board beneath the connector with a detailed description of each as follows:

- ⚡ This is the system's ground point and is the "common" return line for the RS-232 input (RI) and output (RO)
- CO The Clock Output (CO) line is used for self clocking cassette tape interface systems. If you do not have a self clocking cassette tape system connected to this interface, this point must be jumpered to the Clock Input (CI) point on the male connector for the system to work. The actual output of this line is a CMOS compatible (not TTL) square wave whose frequency is 1758.8 Hz when the board is programmed for 110 baud operation and 4800.0 Hz when the board is programmed for 300 baud operation.
- CI The Clock Input (CI) is also used for self clocking cassette tape interface systems. If you do not have a self clocking cassette tape system connected to this interface, this point must be jumpered to the Clock Output (CO) point on the male connector for the system to work.
- RI The RS-232 Input (RI) is the interface's voltage activated input which conforms to RS-232 specifications. It is the input to use when tying the computer system to the SWTPC CT-1024 Terminal System via its CT-S serial interface option. If you are not using the RS-232 Input (RI), it must be jumpered to the ground pin of the male connector.
- RO The RS-232 Output (RO) is the interface's voltage activated output which conforms to RS-232 specifications. It is the output to use when tying the computer system to the SWTPC CT-1024 Terminal System via its CT-S serial interface option. When not in use leave open; do not jumper to ground.
- TC The TTY Common (TC) line is the "common" return line for the 20 Ma TTY compatible input and output and the Reader Control (RC) output. Electrically it is the same as the -12 VDC power supply buss.
- TO The 20 Ma TTY Output (TO) is the interface's current activated output. It is the output to use when tying the Computer System to an ASR-33 or similar TTY configured for 20 Ma full duplex operation.
- RC The Reader Control output (RO) is a line which may be used to implement automatic reader/punch operation on a TTY not having the "automatic" function already built in. It does so by activating a reed relay incorporated into the TTY system. Complete details are given later in the instructions.



TI The TTY Input (TI) is the interface's current activated input. It is the input to use when connecting the Computer System to an ASR-33 or similar teletype configured for 20 Ma full duplex operation. If you are not using the TTY Input (TI), it must be jumpered to the TTY Common (TC) pin on the male connector.

#### Attaching the I/O Connector to the Interface

The male I/O connector which is attached to the interface is simply a row of ten pins supported by a nylon base. The longer side of the male connector plugs onto the interface board edge connector while the cable wires going to the control terminal are soldered onto the shorter side of the connector. The cable which goes back to the interface should, if at all possible, be a multi-conductor cable (not supplied with the kit) with a minimum of five separate conductors.

When preparing to attach the cable to the connector, first strip back 2" of the cable's outer insulation. While positioning the cable in line with the male connector's nylon support strip allowing the wires to extend just beyond the last pin on the strip, attach and solder each of the appropriate wires following the wiring diagram (given later in the instructions) oriented so the ground pin ( $\frac{1}{4}$ ) is connected to the shortest wire. It is very easy to melt the body of the nylon connector which will loosen the pins, so be very careful and use a heatsink on each pin between the solder point and connector body where possible. After attaching all of the cable wires bend the connector around the cable a full 180 degrees and secure with two wire ties (supplied with the kit). Now cut off the indexing pin on the male connector.

#### Configuring the Interface(s)

When operating the interface in the TTY mode you must have the serial control interface (MP-C) configured for 110 baud operation as was detailed earlier in the instructions. In this mode the interface operates at 110 baud with one start bit, 8 data bits (no parity) and two stop bits. TTY's operate with this same fixed data format.

When operating the interface in the RS-232 mode you may operate it at either 110 or 300 baud (jumper programmable as detailed earlier in the instructions). You must of course have the terminal's interface (CT-S board on the CT-1024 configured for the same baud rate. The 300 baud rate is preferable if your terminal will handle it. This will make future cassette tape stored data transfer three times faster than it would be at 110 baud operation. No matter which baud rate you select, the terminal must be configured for handling 8 data bits, with bit 8 either a zero or one but preferably a 0, with no parity selection. There should be two stop bits for 110 baud operation and one stop bit for 300 baud operation. Details for configuring the parity and bit arrangements of the CT-S interface on the CT-1024 terminal system are in the CT-S instruction set. The CT-S interface automatically selects two stop bits for 110 baud operation and one stop bit for 300 baud operation.

This completes the assembly phase for the MP-C board. Actual checkout pro-



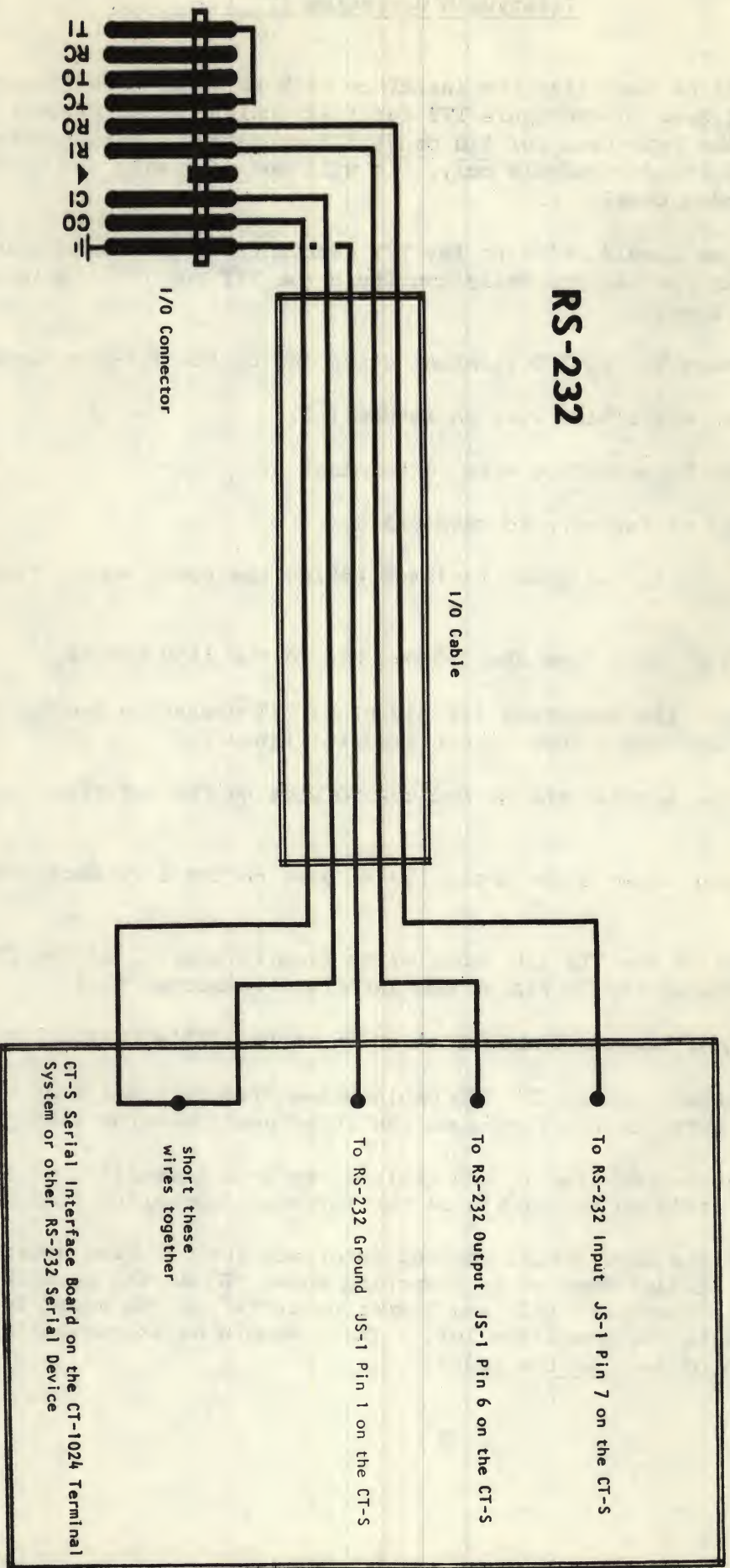
cedures are given in the System Checkout Instructions provided with the MP-B Mother Board, however the System Assembly Instructions are used only after having assembled the MP-A Microprocessor/System Board, MP-B mother board, MP-C serial control interface and the MP-P power supply.

#### RS-232 Operation (CT-1024 Users)

If you will be operating the interface with an ASCII coded, RS-232 terminal such as the CT-1024 terminal system with the CT-S serial interface, you will have to configure both the terminal and computer interfaces for compatible operation.

To interconnect the two, make the connections illustrated in Figure 1.

- ( ) Run a jumper between the TI and TC pins on the interface connector plug.
- ( ) On the terminal end of the I/O cable solder two of the wires in the cable together. On the computer's interface connector plug end attach one of these wires to the CI pin and the other to the CO pin.
- ( ) Attach another of the terminal I/O cable wires from the RS-232 output of the terminal's serial interface (CT-S jack JS-1 pin 6) to the RI pin on the computer's interface connector plug.
- ( ) Attach another of the terminal I/O cable wires from the RS-232 input of the terminal's serial interface (CT-S jack JS-1 pin 7) to the RO pin on the computer's interface connector plug.
- ( ) Attach another of the terminal I/O cable wires from the ground of the terminal's serial interface (CT-S JS-1 pin 1) to the  $\frac{1}{2}$  pin on the computer's interface connector plug.
- ( ) Be sure you have configured the baud rate and parity of both the computer and terminal interfaces as called for earlier in the instructions.



**Figure 1**      **Wiring Diagram - Attaching a Serial RS-232 Device to the MP-C or MP-S Interfaces**



## Teletype<sup>®</sup> Operation (TTY)

If you will be operating the interface with an ASCII coded Teletype<sup>®</sup> (TTY), you will have to configure TTY for full duplex, 20 Ma current loop operation and the interface for 110 baud, TTY operation. The interface will work with ASCII coded terminals only. It will not work with the older 5-level baudot coded terminals.

Although you should refer to the TTY manufacturer's documentation for specific details you can generally configure the TTY for full duplex, 20 Ma operation as follows:

(In reference to the I/O terminal strip inside the TTY-see figure 2)

- ( ) Connect the white/blue wire to terminal 5.
- ( ) Connect the brown/yellow wire to terminal 5.
- ( ) Connect the violet wire to terminal 9.

(In reference to the power resistor behind the power supply inside the TTY)

- ( ) Move the blue wire from the 750 ohm tap to the 1450 ohm tap.

To configure the interface for 110 baud, TTY operation and for attachment to the TTY, make the connections illustrated in figure 2.

- ( ) Run a jumper between the CI and the CO pins on the interface connector plug.
- ( ) Run a jumper between the ~~+~~ and the RI pins on the interface connector plug.
- ( ) Attach one of the TTY I/O cable wires from terminal 7 of the TTY's terminal strip to the TO pin on the interface connector plug.
- ( ) Run a jumper between terminals 4 and 6 on the TTY's terminal strip.
- ( ) Attach another of the TTY I/O cable wires from terminal 6 of the TTY's terminal strip to the TC pin on the interface connector plug.
- ( ) Attach another of the TTY I/O cable wires from terminal 3 of the TTY's terminal strip to the TI pin on the interface connector plug.
- ( ) Configure the MP-C serial control interface for 110 baud operation if you have not already done so by jumpering point "C" on the board to the "110" pad to its immediate left and jumper point "D" on the board to the separate "110" pad to its immediate left. There should be no connections to either of the "300" pads on the board.



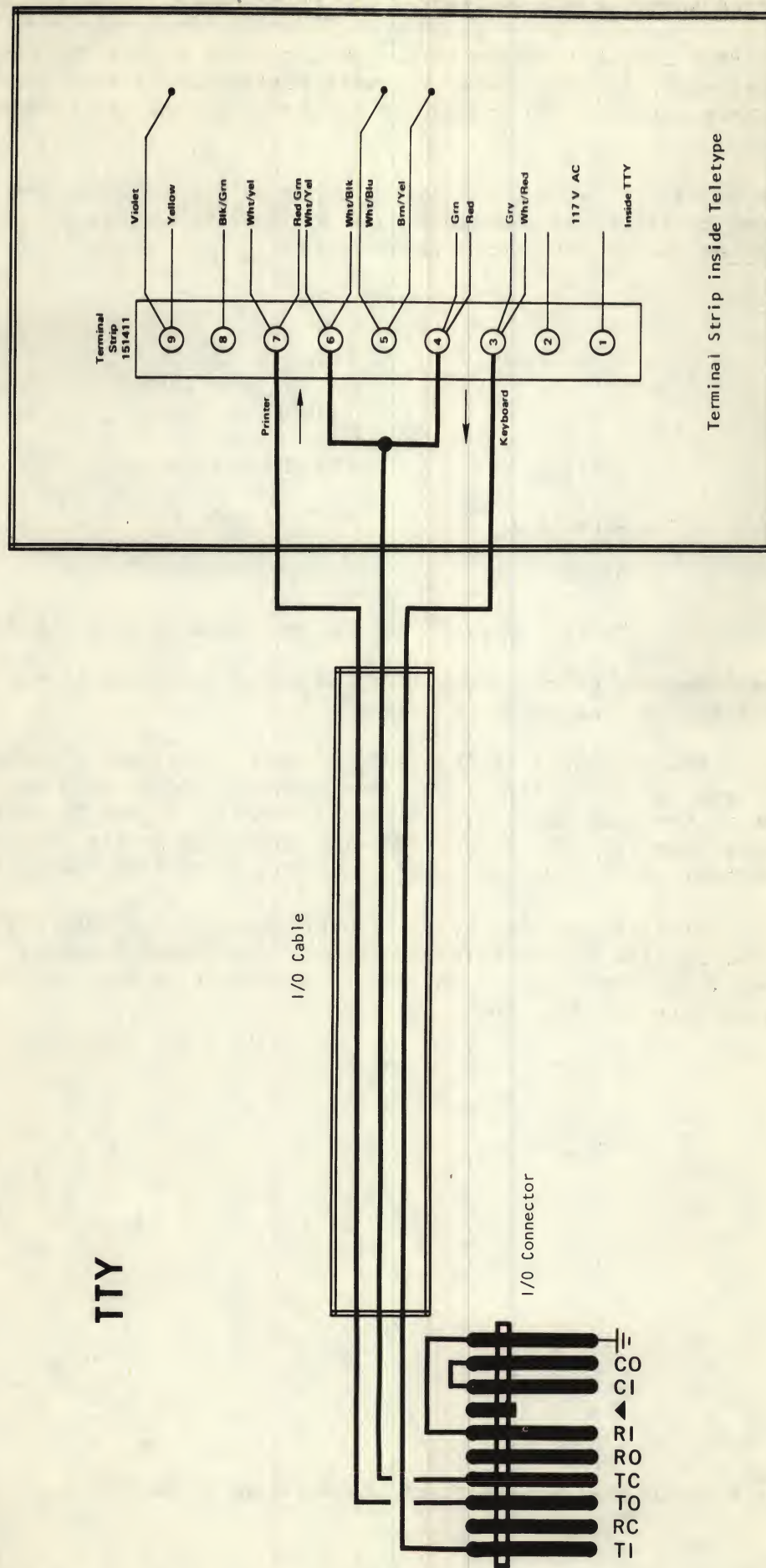


Figure 2 Wiring Diagram - Teletype Configuring and Connections to the MP-C or MP-S Interfaces



The selected board is now configured for full duplex, 20 Ma TTY operation.

The SWTPC 6800 Computer System is designed to work with a TTY having an automatic reader/punch feature (under software control). If your teletype does not have this feature, you can add it by incorporating the following modifications:

- ( ) Using the parts list below, the parts layout in figure 3 and the schematic shown in figure 5, construct the circuit on a piece of vector board. Note: We do not supply these parts.

PARTS LIST:

1 EA.	Reed Relay	12V, 600 ohm coil Potter Brumfield # JR-1005 or equiv.
1 EA.	Resistor	470 ohm 1/2 watt
1 EA.	Capacitor	0.1 mfd @600 VDC
1 EA.	Diode	1N5060 or equiv.
1 EA.	Board	Vector Board (2.5" x 3.8")

- ( ) Mount the component board on the teletype using the holes in the terminal's mounting plate as shown in figure 4.
- ( ) Referring to the schematic in figure 5, connect the relay, capacitor and resistor into the TTY's circuitry. The LINE and LOCAL lines must be connected to the line/off/local switch as shown in figure 5. Make sure no voltages from the TTY are accidentally connected to the relay's primary windings. Such a voltage can damage the SWTPC 6800 Computer System.
- ( ) The relay coil is controlled by the reader control line (RC) with respect to the TC line on the interface board, so be sure to connect the relay's coil windings back to the RC and TC points on the interface connector plug thru the I/O cable.

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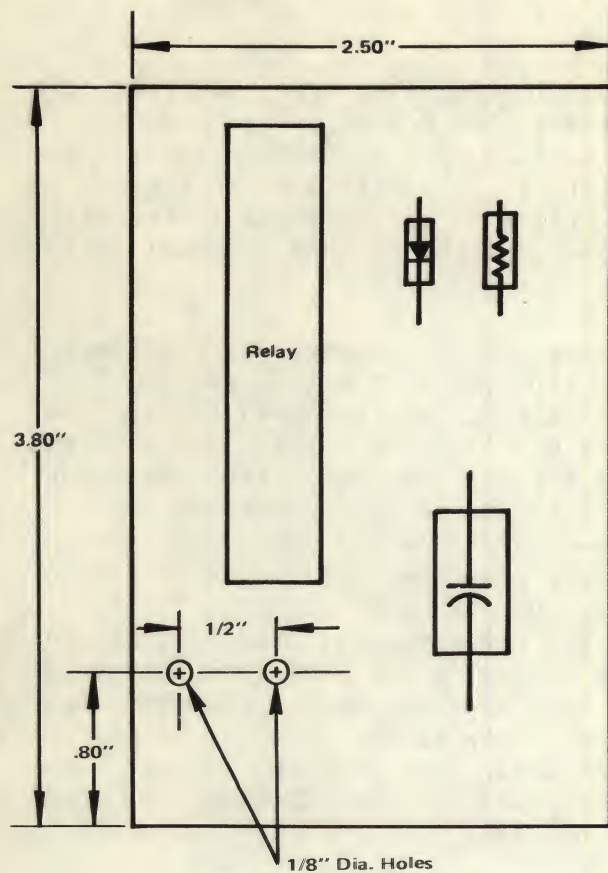
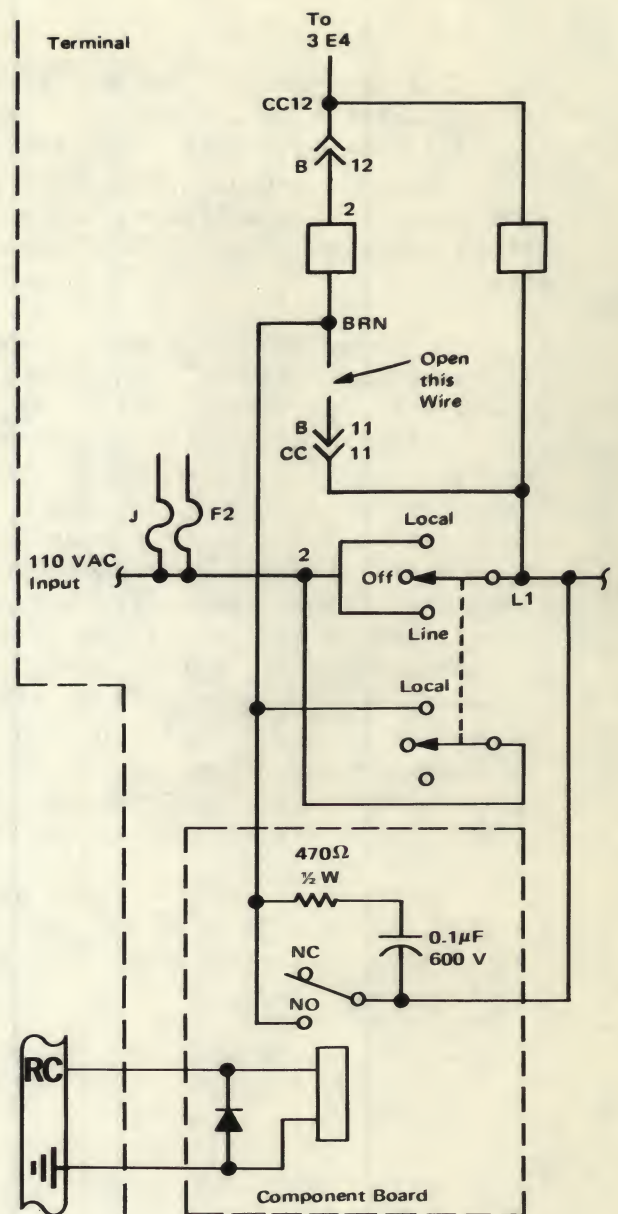


Figure 3



Figure 4



TTY Terminal Schematic Incorporating Automatic Reader Control

Figure 5

Upgrading a Teletype for Automatic Reader/Punch Operation



### How It Works

The MP-C Serial Control Interface uses IC1 a parallel type interface chip to communicate with a serial, control terminal. The actual serial encoding and decoding including start and stop bits is done by the computer itself using software, not hardware. The parallel interface chip is used to provide the latching and buffering necessary to interface to the computer to the terminal's serial input/output lines. (CT-S board on the CT-1024 Terminal System).

In addition, two control inputs and three control outputs are provided. By jumpering point "C" on the board to the "110" pad to its left the board is configured for 2 stop bits. By jumpering point "C" on the board to the "300" pad to its left, the board is configured for one stop bit. This is one of the control inputs. The other control input is derived indirectly from the input fed to baud rate selection pad, point "D". It is used for generating the timing signals to correctly encode and decode serial data at the selected baud rate. The PB0 and PB2 outputs of IC1 are also indirectly used to provide the timing signals for 5 stage divider, IC3 and NAND gate IC4, to correctly encode and decode the serial data. The CB2 output is used to generate a "Reader Control" output which may be used for TTY's not have inte automatic reader/punch function. It is also used to give program control over the input to output "echo" function of the interface. NAND gate IC5 provides the OR ing of computer generated data or input "echoed" data (when enabled) so that both are transmitted to the terminal. Optional Couplers IC7 thru IC9 are used for isolation on the various interface inputs/outputs.

Both -12 and +12 voltages are required by the interface for RS-232/TTY communication. These lines are not regulated and are derived from the computer's power supply board. +5 VDC power for the board is supplied by voltage regulator IC2.



# Parts List MP-C Serial Control Interface.

## Resistors

✓ R1, R2, R3	680 ohm 1/4 watt resistor
✓ R4, R5	10K " " " "
✓ R6	47K " " " "
✓ R7	2.7K " " " "
✓ R8	1.1K ohm 1 watt resistor
✓ R9	330 ohm 1/2 watt resistor
✓ R10	820 ohm 1 watt resistor
✓ R11	100 ohm 1/4 watt resistor

## Capacitors

✓ C1	0.1 mfd mylar capacitor
✓ C2	0.1 mfd disc capacitor

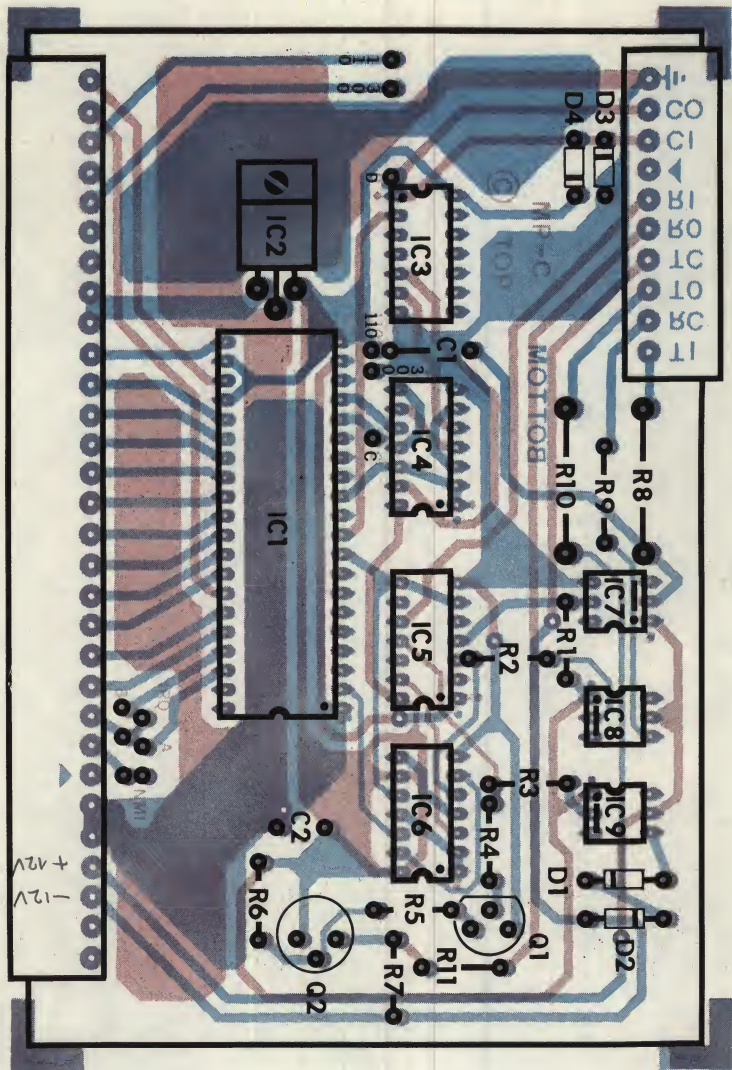
## Semiconductors

✓ D1, D2	1N4003 silicon diode
✓ D3, D4	1N914/1N4148 silicon diode (sm.glass case)
✓ Q1	2N5210 silicon transistor
✓ Q2	SS1122 silicon transistor
IC1	MC6820 peripheral interface adaptor (MOS)
IC2	7805 5 VDC voltage regulator
IC3	CD4024AE CMOS binary counter (MOS)
IC4	CD4011A CMOS quad NAND gate (MOS)
✓ IC5	1489AJ quad RS-232 receiver
✓ IC6	7400 quad NAND gate
✓ IC7 - IC9	4N33 optical coupled isolator













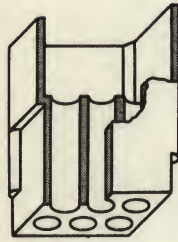


# Connector Reference Sheet

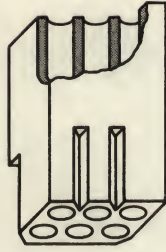
In order to avoid confusion in distinguishing between the various connectors supplied with our many kits, we are including this connector reference sheet with the kit instruction set. We have had a great many customers interchange the male and female connector shells when assembling their kits so we have clearly illustrated each connector along with its proper name and gender on this reference sheet. All are shown actual size.



Male Pin



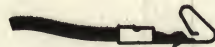
Molex Female Shell Connector



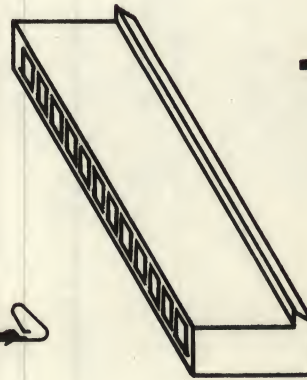
Molex Male Shell Connector



Female Pin



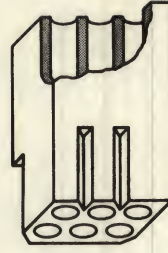
Pin for Harness Connector



Harness  
Connector



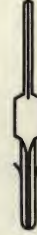
Molex Wafercon<sup>®</sup>



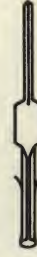
Molex Male Shell Connector



Straight Pin  
Edge Connector



Male Solder Tail Pin  
PC Type



Female Solder Tail Pin  
PC Type



